Specification

Absolute Value Calculating Element

Field of the Invention

The present invention relates to an absolute value calculating element for converting alternating-current signals into direct-current signals.

Description of the Prior Art

Conventionally known absolute value calculating means for performing absolute value calculation of alternating voltage signals and converting the same into direct-current voltage signals are full-wave rectification circuits arranged by assembling diodes or circuits in which such circuits are combined with transformers.

However, it will be suffice to provide a single diode in case of performing half-wave rectification in such a circuit employing diodes while remaining half-waves will not be output but ignored. On the other hand, a plurality of elements to be imposed will be required in case of forming a circuit in which full-wave rectification is performed so that forming the circuit will be troublesome. Moreover, while both of these circuits enable conversion in an effective manner since electric signals are directly converted into electric signals, forward voltage drop owing to diodes will not be zero so that it may cause errors in

case of performing absolute value calculation of minute signals by using diodes.

The present invention has thus been made in view of these problems, and it is a subject thereof to provide an absolute value calculating element for converting alternating-current signals into direct-current signals with a small amount of imposed elements and without causing specific voltage drop.

Summary of the Invention

For solving the above subject, the invention of Claim 1 is provided with electrostrictive elements and a detecting means for detecting an amount of deformation thereof, wherein an alternating-current signal is calculated into an absolute value and output by impressing the alternating-current signal to the electrostrictive elements for deforming the same and by converting a distortion of the electrostrictive elements into an electric signal by using the detecting means.

In the invention of Claim 2, a piezoelectric/electrostrictive element is provided that is deformed in proportion to the amount of deformation of the electrostrictive elements in the invention of Claim 1, wherein an alternating-current signal is calculated into an absolute value and output by impressing the

alternating-current signal to the electrostrictive element for deforming the same and by outputting electromotive force generated by the deformation of the piezoelectric/electrostrictive element.

In the invention of Claim 3, the electrostrictive elements and the piezoelectric/electrostrictive element are overlapped and pinched between a rigid body that is not deformed in the invention of Claim 2.

In the invention of Claim 4, one end of the electrostrictive elements in a deforming direction thereof is fixed while the other end of the electrostrictive element is fixedly attached to one surface of an elastic plate body, which one end is fixed and its other end is formed as a free end, and a plate-like piezoelectric/electrostrictive element is fixedly attached to the other surface of the elastic plate body in the invention of Claim 2.

In the invention of Claim 5, the electrostrictive elements and the piezoelectric/electrostrictive element are formed to assume a plate-like shape in the invention of Claim 2, wherein the electrostrictive elements are fixedly attached to one surface of the plate-like elastic plate body while the piezoelectric/electrostrictive element is fixedly attached to the an opposing surface of the plate-like elastic body.

Brief Explanation of the Drawings

Fig. 1 is an explanatory view showing one example of an absolute value calculating element of an embodiment of the present invention.

Fig. 2 is a view showing characteristics of impressed voltage-deformation of electrostrictive elements.

Fig. 3 is an explanatory view showing another embodiment of the present invention.

Fig. 4 is an explanatory view showing still another embodiment of the present invention.

Description of the Preferred Embodiments

Embodiments for materializing the present invention will now be explained with reference to the drawings. Fig. 1 is a schematic view showing one example of an absolute value calculating element according to the present invention, wherein an actuator 2 of substantially columnar shape is formed by overlapping a plurality of disk-like shaped electrostrictive elements 1, and a sensor element 3 of substantially identical shape is provided in an overlapping manner to be succeeding to the actuator 2. Both of the actuator 2 and the sensor element 3 are pinched between a rugged rigid body 4 that will not be deformed, and the sensor element 3 is provided to be deformable in accordance with deformations in the actuator 2 such that

a dimension ℓ in an entire height direction as illustrated in Fig. 1 becomes constant. An alternating signal source 5 is connected to each of the electrostrictive elements 1 of the actuator 2 so that electromotive force of the sensor element 3 will be extracted.

It should be noted that the sensor element 3 be preferably a piezoelectric element, e.g. of PZT, it is alternatively possible to employ, instead of such an element utilizing piezoelectric effects, elements exhibiting piezoresistant effects such as a semiconductor gauge, an element utilizing magnetoresistant effects, a differential transformer, an eddy-current sensor, an element for detecting variations in capacities, or an electrostrictive element. Moreover, the actuator 2 may be a conventionally known MLP in which a plurality of electrostrictive elements is formed to assume a laminated structure. However, in case a piezoelectric element is formed of ceramics such as PZT to be used as the sensor element, the actuator may be similarly formed of ceramics such that both members may be integrally formed in a simple and effective manner.

Since the electrostrictive elements 1 are deformed in an identical direction upon receipt of positive/negative voltage signals as illustrated in the characteristics of impressed voltage-deformation of Fig. 2, the actuator 2

will be accordingly deformed in an identical direction upon impressing positive/negative voltage signals for performing absolute value calculating actions. Thus, an electric signal such as electromotive force that is expressed as an absolute value will be generated from the sensor element that is deformed in accordance with the actuator 2.

Since absolute value calculation of alternating-current signals may be performed by an integrally formed element, high-integration is enabled without the necessity of arranging a different circuit, and output of absolute values of favorable characteristics may be obtained with small input signals since electrostrictive elements do not exhibit threshold characteristics such as forward voltage drop as it is the case with diodes.

Since the arrangement does not perform direct conversion of electric signals to electric signals, inputs and outputs may be electrically isolated from each other so that no conducting condition will be generated between inputs and outputs even in case of degradations or damages of elements. It is further possible to provide a mechanism that does not respond to high frequencies since mechanical displacements are interposed, and it is accordingly possible to incorporate functions of a low pass filter.

Fig. 3 illustrates another embodiment in which a fixed

bottom surface 7a and a wall surface 7b are provided onto which bottom surface the actuator 2 is fixed. Its upper surface 2a is fixedly attached to a rear surface of an elastic plate-like body 8 with one end thereof being fixed to the wall surface, and a plate-like sensor element 9 is fixedly attached to an upper surface of the plate-like body 8. The sensor element 9 may be preferably comprised of a piezoelectric unimorph.

Also with this arrangement, deformation of the actuator 2 causes deflection of the plate-like body 8 so that the sensor element 9 is accordingly deformed or distorted through the deflection to thus generate electromotive force. It is thus possible to perform absolute value calculation of the alternating voltage signals and to output the absolute value signals. It should be noted that the plate-like body 8 may be a metallic plate or formed of resin or ceramics.

In case the elastic plate-like body is interposed, an actuator 10 may be similarly formed to assume a plate-like shape in addition to the sensor element 9 as illustrated in Fig. 4. In this manner, the entire absolute value calculating element may be manufactured in a simpler manner.

For obtaining a sufficient amount of deformation of the actuator 2, alternating-current signals to be input

shall be amplified by using an operational amplifier or the like such that output signals expressed as absolute values and having high S/N ratios may be obtained.

As explained so far in details, the present invention enables it to perform absolute value calculation of alternating-current signals by using an integrally formed element and to perform high-integration without the necessity of providing a peripheral circuit. Though diodes would cause voltage drop though it may be a forward one, a piezoelectric/electrostrictive element will not exhibit such threshold-like characteristics so that it is possible to perform absolute value calculation in a favorable manner also with small signals. Since no direction conversion of electric signals into electric signals is performed, the input and output may be electrically isolated.